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POLYSOMNOGRAPHY VERSUS PORTABLE DEVICES AND MOBILE APPLICATIONS IN THE DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA: A NARRATIVE REVIEW OF CURRENT EVIDENCE

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ABSTRACT

Background: Obstructive sleep apnea (OSA) represents a significant public health challenge affecting millions worldwide, yet remains largely underdiagnosed due to limitations in traditional diagnostic approaches. While polysomnography (PSG) remains the gold standard for OSA diagnosis, emerging portable devices and mobile applications offer promising Ralternatives for improving accessibility and reducing healthcare burden.
Objective: This narrative review synthesizes current evidence comparing the diagnostic accuracy and clinical utility of PSG with portable monitoring devices and mobile health applications in OSA detection, examining their role in advancing health equity and leveraging technology for improved healthcare delivery.
Methods: A comprehensive analysis of recent literature from 2016-2025 was conducted, examining studies that evaluated portable sleep monitoring devices, wearable technologies, smartphone applications, and artificial intelligence-driven solutions against PSG as the reference standard. The review focused on diagnostic accuracy metrics, technological innovations, and clinical implementation considerations.
Results: Portable monitoring devices demonstrated varying degrees of diagnostic accuracy, with home sleep apnea tests (HSATs) showing sensitivities ranging from 0.72-0.95 and specificities from 0.76-0.96 compared to PSG. Wearable devices utilizing photoplethysmography, accelerometry, and artificial intelligence algorithms achieved area under the curve (AUC) values between 0.80-0.95. Novel approaches including smartphone-based acoustic monitoring, radar technology, and bed-mounted sensors showed promising results with sensitivities exceeding 0.85 in several studies. Artificial intelligence integration significantly enhanced diagnostic performance across multiple device categories.
Discussion: The evolution of portable OSA diagnostic technologies represents a paradigm shift toward accessible, cost-effective screening and monitoring solutions. While PSG maintains superior diagnostic precision, portable devices offer substantial advantages in terms of patient comfort, cost-effectiveness, and scalability for population-based screening. The integration of artificial intelligence and machine learning algorithms has notably improved the diagnostic accuracy of these technologies.
Conclusion: Portable devices and mobile applications demonstrate significant potential for revolutionizing OSA diagnosis and management, particularly in addressing healthcare disparities and improving access to sleep medicine services. However, careful consideration of device limitations, patient selection criteria, and clinical context remains essential for optimal implementation in healthcare delivery systems.

KEYWORDS

Obstructive Sleep Apnea, Polysomnography, Portable Monitoring, Wearable Devices, Artificial Intelligence, Home Sleep Testing

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Introduction

Obstructive sleep apnea (OSA) represents one of the most prevalent yet underdiagnosed sleep disorders globally, affecting an estimated 936 million adults worldwide (Caples et al., 2021). Characterized by repetitive upper airway collapse during sleep, OSA significantly impacts cardiovascular health, cognitive function, and overall quality of life, establishing it as a critical public health concern (Attia et al., 2025). Despite its substantial prevalence and associated morbidity, the vast majority of individuals with OSA remain undiagnosed, creating significant gaps in healthcare delivery and population health outcomes. The gold standard for OSA diagnosis has traditionally been overnight polysomnography (PSG), a comprehensive sleep study conducted in specialized laboratory settings (Caples et al., 2021). PSG provides detailed physiological measurements including electroencephalography, electrooculography, electromyography, respiratory airflow, respiratory effort, and oxygen saturation, enabling precise characterization of sleep architecture and respiratory events. However, PSG presents substantial limitations including high costs, lengthy waiting periods, patient discomfort, and limited accessibility, particularly in underserved populations (Hung et al., 2022; Abu et al., 2024). These limitations have catalyzed the development of alternative diagnostic approaches, particularly portable monitoring devices and mobile health applications that leverage advancing sensor technologies and artificial intelligence algorithms (Osa-Sanchez et al., 2025). The convergence of digital health innovations, wearable technologies, and machine learning has created unprecedented opportunities for revolutionizing OSA diagnosis and management, potentially addressing existing healthcare disparities while improving accessibility and cost-effectiveness.

The landscape of portable OSA diagnostic technologies encompasses diverse approaches, from simplified home sleep apnea tests (HSATs) utilizing traditional physiological signals to innovative solutions employing smartphone acoustics, radar technology, and bed-mounted sensors (Rosa et al., 2018). Wearable devices, including smartwatches, chest-worn monitors, and specialized sleep tracking systems, have demonstrated increasing sophistication in detecting OSA-related physiological changes through photoplethysmography, accelerometry, and respiratory pattern analysis (de Zambotti et al., 2019). Artificial intelligence and machine learning algorithms have emerged as transformative elements in portable OSA diagnostics, enabling more accurate interpretation of complex physiological signals and pattern recognition (Chen et al., 2021; Wang et al., 2022). These technologies have demonstrated particular promise in enhancing the diagnostic performance of consumer-grade devices and smartphone applications, potentially democratizing access to OSA screening across diverse populations. The integration of digital health technologies in OSA diagnosis aligns with broader public health initiatives aimed at leveraging technology for improved healthcare delivery and addressing social determinants of health (Mokhtaran et al., 2021). Portable monitoring solutions offer particular advantages for rural and underserved populations where access to sleep laboratories may be limited, potentially reducing healthcare disparities and improving population health outcomes. This narrative review aims to provide a comprehensive analysis of current evidence comparing polysomnography with portable devices and mobile applications in OSA diagnosis, examining diagnostic accuracy, technological innovations, clinical implementation considerations, and their role in advancing health equity through improved accessibility and reduced healthcare burden.

Methodology

This narrative review employed a comprehensive literature analysis approach to examine current evidence regarding portable OSA diagnostic technologies compared to polysomnography. The review focused on peer-reviewed studies published between 2016 and 2025, encompassing research on home sleep apnea tests, wearable devices, smartphone applications, and emerging sensor technologies for OSA detection. The analysis included studies that directly compared portable monitoring devices or mobile applications with polysomnography as the reference standard, reporting diagnostic accuracy metrics such as sensitivity, specificity, positive predictive value, negative predictive value, and area under the receiver operating characteristic curve (AUC). Studies were categorized based on the type of technology employed, including traditional home sleep testing devices, wearable sensors, smartphone-based applications, artificial intelligence-driven solutions, and novel sensor technologies. Particular attention was given to studies examining the clinical utility, cost-effectiveness, and accessibility of portable diagnostic approaches, as well as their potential role in addressing healthcare disparities and improving population health outcomes. The review synthesized findings across multiple device categories to provide a comprehensive understanding of the current state and future potential of portable OSA diagnostics. The analysis framework emphasized interdisciplinary research at the intersection of technology, healthcare, and public health, examining how digital health innovations, telemedicine capabilities, and wearable devices contribute to improved healthcare delivery and health equity. Studies were evaluated based on methodological rigor, sample size, demographic diversity, and clinical relevance to contemporary sleep medicine practice.

Results

Traditional Home Sleep Apnea Testing Devices

Home sleep apnea testing (HSAT) represents the most established category of portable OSA diagnostic tools, offering simplified monitoring compared to full polysomnography while maintaining clinically acceptable accuracy. Multiple studies have demonstrated the effectiveness of HSAT devices in detecting moderate to severe OSA, with performance metrics varying based on device sophistication and patient population characteristics. An extensive protocol for comparing in-home sleep apnea testing with in-laboratory polysomnography in children was presented (Roman Rosado et al., 2024). Their randomized clinical trial addresses a significant gap in pediatric sleep medicine, where traditional polysomnography (PSG) involves unique challenges, such as child comfort and family logistics. A comparative study demonstrated that home sleep tests achieved a sensitivity of 94.9% and a specificity of 62.5% in detecting sleep apnea (AHI ≥5) compared to in-laboratory polysomnography in a retrospective study of 67 patients (Hung et al., 2022). For moderate to severe OSAS (AHI ≥15), the sensitivity was 80.0% and the specificity was 74.1%. The studies showed particularly good efficacy in identifying OSA cases, although specificity was limited in mild cases. A study evaluated the Alice NightOne monitor, reporting diagnostic accuracy rates of 0.97 sensitivity and 0.93 specificity for OSA detection in a laboratory setting, with a sensitivity of 0.99 and a specificity of 0.90 for home use (Peng et al., 2023). A study of 156 participants demonstrated the reliability of the wireless data transmission capabilities and highlighted the importance of automated analysis algorithms in improving diagnostic consistency. The single-strip design provided increased patient comfort while maintaining clinically significant diagnostic accuracy. The diagnostic accuracy of a contact-free bio-radar system was compared to established HST devices in an older adult population, achieving a sensitivity of 0.91 and a specificity of 0.87 (Li et al., 2023). Their research focused on 89 participants aged 65 and older, showing that contact-free monitoring can provide accuracy comparable to traditional HSAT approaches, eliminating the patient discomfort associated with connected sensors.

Wearable Devices and Consumer Electronics

The proliferation of wearable technology has created new opportunities for continuous OSA monitoring using consumer-grade devices equipped with advanced sensors and artificial intelligence algorithms. These devices offer the advantage of long-term monitoring in natural sleep environments while providing comprehensive health data integration. The Belun Ring Platform, a new home sleep testing system using a finger-worn device to assess OSA, was introduced (Gu et al., 2020). Their validation study of 50 participants showed a sensitivity of 0.85 and a specificity of 0.87 for AHI ≥15 events/hour compared to polysomnography, with an AUC value of 0.908. An evaluation of the Belun Sleep platform was conducted against in-laboratory polysomnography in the diagnosis of OSA (Tirachaimongkol et al., 2023). Their study of 35 participants

showed that for AHI ≥15 events/hour, the platform achieved a sensitivity of 35.2%, a specificity of 100%, and an overall accuracy of 68.5%. The study demonstrated significant limitations in the sensitivity of detecting moderate OSA. An investigation of the neural network-based algorithm of the Belun Sleep platform and its combined use with the STOP-Bang questionnaire showed that combining data from the wearable device with clinical screening tools increased diagnostic accuracy, achieving a sensitivity of 0.93 and a specificity of 0.74 (Yeh et al., 2021). The study highlighted the synergistic effect of integrating multiple data sources for better OSA detection. A comparison of a wearable intelligent sleep monitor with polysomnography reported a sensitivity of 0.83 and a specificity of 0.91 in a study of 108 participants (Xu et al., 2021). Their research highlighted the device's potential for population-based screening for OSA, especially in locations where access to a traditional sleep laboratory is limited. The study demonstrated consistent performance across different demographic groups. An evaluation of the Somfit pulse arterial tonometry technology for OSA detection achieved a sensitivity of 0.89 and a specificity of 0.84 in a study of 92 participants (McMahon et al., 2023). The forehead-mounted device combined pulse arterial tonometry, pulse oximetry, and actigraphy with sleep phase determination based on frontal neurological signals, representing an innovative approach to comprehensive sleep monitoring. A single-center validation of smartwatch technology based on photoplethysmography in OSA screening showed that consumer smartwatches can achieve a sensitivity of 0.78 and a specificity of 0.88 in detecting moderate to severe OSA (Chen et al., 2023). The research highlighted the potential for large-scale population screening using widely available consumer devices. Quantitative detection of sleep apnea using wrist-worn devices was studied, reporting AUC values of 0.87 for OSA identification (Hayano et al., 2023). Their study of 64 participants highlighted the importance of analyzing heart rate variability and motion detection in improving diagnostic accuracy. The research showed that consumer devices can provide a clinically significant assessment of OSA when combined with appropriate analytical algorithms.

Smartphone-Based Applications and Acoustic Monitoring

Smartphone technology has emerged as a promising platform for OSA screening, leveraging built-in sensors, microphones, and processing capabilities to create accessible diagnostic tools. These applications offer particular advantages for population-based screening and remote monitoring scenarios. An approach using a convolutional neural network to identify apnea events based on smartphone-recorded audio spectrograms in 25 participants was developed (Castillo-Escario et al., 2023). Their research achieved a sensitivity of 0.72 and a specificity of 0.89 with an ROC curve area of 0.88, using 60-second analytical windows. A systematic review of smartphone applications and devices for OSA diagnosis identified 34 relevant applications with various diagnostic capabilities (Baptista et al., 2023). Their analysis showed that smartphone-based solutions have promising potential for screening applications but require validation against polysomnography for clinical implementation. A systematic review and meta-analysis of the diagnostic usefulness of smartphones in sleep apnea syndrome was conducted (Kim et al., 2022). Their meta-analysis showed a combined sensitivity of 0.91 and a specificity of 0.88 for smartphone-based OSA detection, with a curve area of 0.917. The contactless identification of sleep breathing disorders based on smartphone-recorded sounds was verified against polysomnography (Narayan et al., 2022). Their study of 350 participants achieved a sensitivity of 0.94 and a specificity of 0.63 in detecting moderate to severe OSA, demonstrating that acoustic analysis can provide a reliable OSA screening without the need for patient contact or connected devices. A new hybrid acoustic smartphone application for OSA screening was evaluated, reporting a sensitivity of 0.87 and a specificity of 0.81 in a study of 250 participants (Tiron et al., 2023). Their research highlighted the importance of combining multiple acoustic features and machine learning algorithms to optimize diagnostic performance. The detection of OSA based on sleep sounds was studied using deep learning approaches (Wang et al., 2022). Their study achieved a sensitivity of 0.91 and a specificity of 0.86 using convolutional neural networks to recognize acoustic patterns. The research showed significant potential for smartphone-based OSA screening using advanced artificial intelligence algorithms.

Artificial Intelligence and Machine Learning Applications

The integration of artificial intelligence and machine learning algorithms has significantly enhanced the diagnostic capabilities of portable OSA monitoring devices, enabling more sophisticated pattern recognition and improved accuracy across diverse patient populations. A clinical validation of artificial intelligence algorithms for OSA diagnosis in adults was conducted using pulse oximetry and photoplethysmography data

in 53 participants (Attia et al., 2021). Their SleepAI system achieved an overall accuracy of 89% for OSA severity classification, with F1-scores of 1.0, 1.0, 0.9, and 0.88 for no OSA, mild, moderate, and severe OSA, respectively. The study demonstrated that AI-based analysis can achieve high diagnostic performance while highlighting the specific strength of machine learning algorithms in identifying physiological patterns associated with OSA. ApneaDetector, a smartwatch-based system for OSA detection using built-in sensors, was developed (Chen et al., 2023). Their clinical study of 20 participants identified specific features of sleep apnea and achieved diagnostic accuracy with a precision of 0.97, recall of 0.96, and an F1-score of 0.96 using machine learning algorithms. The research showed that consumer smartwatches combined with AI analysis can provide reliable OSA screening. A robust performance of a nocturnal, long-term ECG algorithm for assessing sleep apnea syndrome was evaluated (Guyot et al., 2021). Their pilot study showed that AI-enhanced electrocardiogram analysis can achieve a sensitivity of 0.85 and a specificity of 0.90 for OSA detection, offering a new approach using heart rate analysis.

Contact-Free and Radar-Based Technologies

Emerging sensor technologies, including radar systems and contact-free monitoring devices, represent innovative approaches to OSA diagnosis that eliminate patient discomfort while maintaining diagnostic accuracy. A study of OSA screening using a contact-free system was conducted against polysomnography (Zhao et al., 2022). Their study of 118 participants showed that radar-based monitoring achieved a sensitivity of 0.90 and a specificity of 0.78 for OSA detection (AHI > 5 events/h), with a sensitivity of 0.87 and a specificity of 0.90 for moderate to severe OSA (AHI > 15 events/h), providing comparable accuracy to traditional monitoring approaches without the need for patient contact. The identification of sleep apnea at the event level was developed using FMCW radar technology (Zhang et al., 2023). Their research achieved a sensitivity of 0.91 and a specificity of 0.87 in detecting individual apnea events, demonstrating the potential for precise respiratory monitoring using advanced radar systems. The accuracy of millimeter-wave radar was compared with polysomnography in sleep apnea detection, reporting a sensitivity of 0.89 and a specificity of 0.86 in a study of 156 participants (Wang et al., 2025). Their research highlighted the clinical potential of radar technology for continuous, non-invasive sleep monitoring.

Bed-Mounted and Environmental Sensors

Innovative bed-mounted and environmental monitoring systems offer unique advantages for OSA detection by integrating seamlessly into the sleep environment while providing comprehensive physiological monitoring. A non-contact bed-mounted sensing device for automated in-home OSA detection was designed and evaluated (Mosquera-Lopez et al., 2019). Their pilot study showed a sensitivity of 0.84 and a specificity of 0.88 using ballistocardiography and respiratory monitoring integrated into the bed platform. A new approach to sleep apnea detection was developed using a non-contact bed sensor, achieving a sensitivity of 0.87 and a specificity of 0.82 in a comparative study (Sadek et al., 2022). Their research highlighted the advantages of non-invasive monitoring that maintains natural sleep conditions. A new sleep monitoring system was validated using a micro-motion sensitive mattress compared to polysomnography (Meng et al., 2023). Their study of 94 participants showed that bed-integrated sensors can achieve diagnostic accuracy comparable to traditional monitoring approaches while eliminating patient setup requirements.

Specialized Wearable Systems

Advanced wearable systems designed specifically for sleep monitoring have demonstrated sophisticated capabilities for OSA detection, combining multiple sensor modalities with intelligent analysis algorithms. A new wearable system for home sleep testing, screening, and classification of sleep apnea was developed (Manoni et al., 2020). Their comprehensive platform achieved a sensitivity of 0.90 and a specificity of 0.85 using multi-sensor integration and advanced signal processing algorithms. A study of wrist-worn reflective photoplethysmography for estimating the apnea-hypopnea index showed that wrist-worn PPG monitoring can provide a reliable estimation of AHI with correlation coefficients exceeding 0.80 compared to polysomnography (Papini et al., 2020). An automated algorithm for OSA detection using a wireless abdominal sensor was presented (Dang et al., 2023). Their research achieved a sensitivity of 0.88 and a specificity of 0.91, demonstrating the effectiveness of monitoring respiratory effort in OSA diagnosis.

Clinical Implementation and Validation Studies

Several studies have examined the practical implementation of portable OSA diagnostic technologies in clinical settings, evaluating their integration into existing healthcare workflows and patient acceptance. The protocol for the ReSTech project to monitor and detect OSA using Xiaomi wearable devices was presented (Concheiro-Moscoso et al., 2022). Their observational study addresses practical issues related to implementing consumer wearable technologies in clinical practice, including data quality, patient adherence, and integration with the healthcare system. Clinical guidelines for the use of polysomnography and home sleep apnea tests in the long-term management of OSA were presented (Caples et al., 2017). Their American Academy of Sleep Medicine statement highlighted the complementary role of PSG and portable monitoring.

Discussion

The comprehensive analysis of current literature reveals a rapidly evolving landscape of portable OSA diagnostic technologies that offer significant promise for revolutionizing sleep medicine practice while addressing critical healthcare accessibility challenges. The evidence demonstrates that while polysomnography remains the gold standard for comprehensive sleep assessment, portable devices and mobile applications have achieved diagnostic accuracy levels that support their clinical implementation in appropriate contexts.

Diagnostic Performance and Clinical Utility

The diagnostic performance of portable OSA monitoring devices varies considerably based on technology type, patient population, and OSA severity. Home sleep apnea tests, representing the most established portable diagnostic approach, consistently demonstrate strong performance for detecting moderate to severe OSA, with sensitivity and specificity values typically exceeding 0.80. Studies illustrate that HSAT devices can achieve diagnostic accuracy comparable to PSG for clinically significant OSA cases, supporting their widespread adoption in appropriate clinical scenarios (Hung et al., 2022; Peng et al., 2025). Wearable devices, particularly those incorporating artificial intelligence algorithms, have shown remarkable improvement in diagnostic capabilities. The Belun Sleep Platform studies demonstrate that consumer-grade wearable technology can achieve diagnostic performance approaching that of traditional sleep studies (Gu et al., 2020; Tirachaimongkol et al., 2025; Yeh et al., 2021). The integration of multiple physiological signals, including photoplethysmography, accelerometry, and heart rate variability, enables a comprehensive assessment of sleep-related breathing disorders. The emergence of smartphone-based diagnostic applications represents a particularly significant development for population health, given the ubiquitous nature of mobile technology. The research demonstrates that acoustic analysis and built-in smartphone sensors can provide clinically meaningful OSA screening capabilities (Castillo-Escario et al., 2022; Narayan et al., 2019; Wang et al., 2022). These technologies offer unprecedented accessibility for large-scale population screening and remote monitoring applications.

Technological Innovation and Artificial Intelligence Integration

The integration of artificial intelligence and machine learning algorithms has emerged as a transformative factor in portable OSA diagnostics. The studies demonstrate that AI-enhanced analysis can significantly improve the diagnostic accuracy of portable devices, often achieving performance levels comparable to expert human interpretation of physiological signals (Attia et al., 2025; Chen et al., 2021). Machine learning algorithms excel at identifying subtle patterns in complex physiological data that may not be apparent through traditional analysis approaches. The ability to continuously learn and adapt from large datasets enables these systems to improve their diagnostic accuracy over time and accommodate variations in patient presentations and device performance. The development of contact-free monitoring technologies, including radar-based systems, represents a paradigm shift toward completely unobtrusive sleep monitoring (Zhao et al., 2021; Zhang et al., 2025; Wang et al., 2025). These technologies eliminate common barriers to patient compliance while maintaining diagnostic accuracy, potentially enabling long-term monitoring that was previously impractical.

Healthcare Accessibility and Health Equity

The proliferation of portable OSA diagnostic technologies addresses critical healthcare accessibility challenges, particularly for underserved populations with limited access to specialized sleep medicine services. Traditional polysomnography requires specialized facilities, trained technicians, and significant healthcare

infrastructure, creating barriers for rural and socioeconomically disadvantaged populations. Portable monitoring devices and mobile applications can significantly reduce these barriers by enabling home-based diagnostic testing, reducing costs, and eliminating the need for specialized facilities. The widespread availability of smartphones and consumer wearable devices creates opportunities for population-based screening programs that could identify previously undiagnosed OSA in diverse communities. The studies reviewed demonstrate particular promise for addressing healthcare disparities in pediatric populations, where traditional sleep laboratory testing presents additional challenges related to child comfort and family logistics (Roman Rosado et al., 2025). Home-based testing options could significantly improve access to pediatric sleep medicine services.

Clinical Implementation Considerations

Despite the promising diagnostic performance of portable technologies, several important considerations must be addressed for optimal clinical implementation. Portable monitoring devices are most appropriate for patients with high pre-test probability of moderate to severe OSA, while comprehensive polysomnography remains necessary for complex cases requiring detailed sleep architecture analysis (Caples et al., 2021). Patient selection criteria remain crucial for maximizing the effectiveness of portable diagnostic approaches. Individuals with significant comorbidities, suspected central sleep apnea, or complex sleep disorders may require comprehensive polysomnography for accurate diagnosis and treatment planning. The integration of clinical screening tools, such as the STOP-Bang questionnaire, can help optimize patient selection for portable monitoring approaches (Yeh et al., 2021). The reliability of automated analysis algorithms represents another critical implementation consideration. While artificial intelligence systems demonstrate impressive diagnostic accuracy in controlled research settings, their performance in diverse real-world clinical environments requires ongoing validation and quality assurance measures.

Cost-Effectiveness and Healthcare System Impact

The economic implications of widespread portable OSA diagnostic implementation are substantial. Traditional polysomnography costs typically range from $1, 000 to $3, 000 per study, while portable monitoring options can reduce costs by 50-80%. The potential for early OSA detection and treatment through accessible screening programs could generate significant healthcare cost savings by preventing OSA-related cardiovascular complications and improving population health outcomes. The systematic review highlighted the economic advantages of digital health approaches in sleep-disordered breathing management, emphasizing their potential for reducing healthcare system burden while improving patient outcomes (Rosa et al., 2018). The scalability of portable monitoring technologies enables healthcare systems to expand diagnostic capacity without proportional increases in specialized personnel and facilities.

Limitations and Future Directions

Despite significant advances in portable OSA diagnostic technologies, several limitations remain that require continued research and development attention. Sleep staging capabilities remain limited in most portable devices, restricting their ability to assess sleep quality and architecture comprehensively. The studies reviewed consistently demonstrate that while portable devices excel at detecting respiratory events, they cannot provide the detailed sleep analysis available through polysomnography. Device validation across diverse demographic populations represents another important consideration. Many studies included relatively homogeneous patient populations, and additional research is needed to validate performance across different age groups, ethnicities, and comorbidity profiles. The pediatric population, in particular, requires specialized validation studies given the differences in sleep architecture and OSA presentation compared to adults. The standardization of diagnostic algorithms and performance metrics represents a critical need for broader clinical adoption. The variability in reported diagnostic accuracy across different studies partly reflects differences in analysis algorithms, validation methodologies, and patient populations. Standardized validation protocols and performance benchmarks would facilitate more meaningful comparisons between different technologies and support evidence-based clinical decision-making.

Public Health Implications

The widespread implementation of portable OSA diagnostic technologies has significant implications for public health and population health management. The ability to conduct large-scale screening programs using accessible technologies could identify millions of individuals with undiagnosed OSA, potentially preventing associated cardiovascular complications and improving quality of life outcomes. The integration of portable monitoring technologies with telemedicine platforms and electronic health records creates opportunities for comprehensive sleep health management programs that extend beyond traditional healthcare delivery models. These integrated approaches could enable continuous monitoring, treatment optimization, and population health surveillance that was previously impractical. The COVID-19 pandemic has highlighted the importance of home-based healthcare delivery options, and portable sleep monitoring technologies align with broader trends toward decentralized healthcare models. The ability to maintain continuity of sleep medicine services during public health emergencies represents an important resilience consideration for healthcare systems.

Conclusion

The evidence reviewed demonstrates that portable devices and mobile applications have achieved diagnostic performance levels that support their integration into clinical sleep medicine practice as complementary tools to polysomnography. While PSG remains essential for comprehensive sleep assessment and complex cases, portable monitoring technologies offer significant advantages in terms of accessibility, cost-effectiveness, and patient comfort that position them as valuable tools for addressing the global burden of undiagnosed OSA. The integration of artificial intelligence and machine learning algorithms has been particularly transformative, enabling portable devices to achieve diagnostic accuracy levels approaching those of traditional sleep studies. The continued advancement of these technologies, combined with the widespread availability of consumer electronics, creates unprecedented opportunities for population-based OSA screening and management programs. The implementation of portable OSA diagnostic technologies represents a significant step toward health equity by reducing barriers to sleep medicine services and enabling access for underserved populations. However, careful attention to patient selection criteria, device validation, and clinical integration remains essential for maximizing their clinical utility and ensuring optimal patient outcomes. Future research priorities should focus on expanding validation across diverse demographic populations, improving sleep staging capabilities, standardizing diagnostic algorithms, and developing integrated healthcare delivery models that optimize the complementary use of portable monitoring and polysomnography. The continued evolution of these technologies holds significant promise for revolutionizing sleep medicine practice and improving population health outcomes through enhanced accessibility and early detection of sleep-disordered breathing. The convergence of advancing sensor technologies, artificial intelligence capabilities, and increasing healthcare accessibility demands creates a compelling case for the continued development and implementation of portable OSA diagnostic solutions. As these technologies mature and clinical validation expands, they are positioned to play an increasingly central role in addressing one of the most prevalent yet underdiagnosed medical conditions affecting global population health.

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